ANNUAL REPORT OF THE SAVENAC NURSERY

By

D. S. Olson

January, 1916.

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PREFACE.

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Transportation facilities for the nursery are ideal. The "Yellowstone Trail"---northern highway---passes through Savenac; all trains stop at Haugan on the Chicago, Milwaukee & St. Paul Railroad, one-half mile from the nursery; and all trains may be flagged at Wence Spur, on the Northern Pacific Railroad, less than one-fourth mile from the nursery.

PREFACE.

In a "Report on Nursery Site" dated July 20, 1909, E. C. Clifford described the location, area, soil, water, etc., of the site which he recommended to be known as the "Savenac Nursery." It is located on the Savenac Administrative Site, Haugan, Montana, in Section 22, T. 19 N., R. 30 W., M. P. M., at an elevation of 3,150 feet. The nursery area is composed of three benches rising above Savenac Creek. The bench on which the main seedbed area and building are located contains 1½ acres, the second bench, also planted in seedbeds, contains ¾ acres, and the third bench, lying about 48 feet above the first bench devoted to transplants, seedbeds, truck garden and hay land, contains 25¼ acres---total of 27½ acres. The total area is cleared and under cultivation.

Transportation facilities for the nursery are ideal. The "Yellowstone Trail"---northern highway---passes through Savenac; all trains stop at Haugan on the Chicago, Milwaukee & St. Paul Railroad, one-half mile from the nursery; and all trains may be flagged at Hence Spur, on the Northern Pacific Railroad, less than one-fourth mile from the nursery.

Starting in the fall of 1909, a mushroom-like growth of the Savenac Nursery continued until by the fall of 1912 it was the largest in the Service. This growth is due to two things: first, to the fact that it is ideally situated for supplying stock to the entire western part of the District; and second, to the fact that during that period a complete change in the reforestation policy of the District took place, resulting in the determination to put practically all of the money available for the work in this District, into the white pine region..

Mr. Clifford proposed a capacity of 1,000,000 seedlings. In a report dated August 3, 1909, he outlined the capacity at 1,500,000 as follows:

Western white pine - - - - - - - - -	500 M.
Western yellow pine - - - - - - - - -	500 M.
Douglas fir - - - - - - - - - - - -	250 M.
Engelmann spruce - - - - - - - - - -	250 M.

The actual construction work started under G. B. McDonald in September, 1909, when 50 shade frames were partially completed, the water system nearly completed, (½ mile of ditch being constructed and 510 feet of one-inch pipe on the ground) and 3 acres cleared and plowed, with 3 acres partially cleared.

The first sowing was done on June 8-10, 1910, as follows:

Species.	M.	Lbs. Seed per 12' Bed.
W. yellow pine	519.12	3.5
Engelmann spruce	331.60	.75
Douglas fir	182.90	3.0
W. white pine	15.70	5.0
W. larch	13.00	3.0
E. white pine	5.80	5.0
Sugar pine	.30	---
Total----	1,068.42	

It was aimed to get 10,000 seedlings per bed in Western yellow pine and Western white pine.

A total of 10,150 Eastern white pine and Western yellow pine seedlings were transplanted in the spring of 1910 at a cost of $2.75 per M.

The fires of 1910 killed all of the Western yellow pine transplants and most of the Western white pine, the seedbeds being uninjured. All buildings then on the site were wiped out.

The stock from the St. Regis Nursery was gradually disposed of by shipment to the field or to Savenac, and the former nursery was abandoned in 1912.

In the spring of 1912 the capacity of Savenac Nursery, as authorized by the Washington Office, was 3,500,000, this being raised the following spring to 3,750,000 with the stock grown, proportioned as follows:

W. white pine----------	75.00%
W. yellow pine----------	22.50%
W. larch----------	1.20%
Engelmann spruce-------	.70%
W. red cedar----------	.30%
E. white pine----------	.30%
Total---	100.00%

Although authorized at a capacity of 3,750,000,

Species.	M.	Lbs. Seed per 12' bed.
W. yellow pine	819.12	5.8
Engelmann spruce	381.60	.75
Douglas fir	182.90	5.0
W. white pine	18.70	6.0
W. larch	13.00	3.0
K. white pine	8.80	6.0
Sugar pine	.50	---
Total---	1,068.42	

It was aimed to get 10,000 seedlings per bed in Western yellow pine and Western white pine.

A total of 10,180 Western white pine and Western yellow pine seedlings were transplanted in the spring of 1910 at a cost of $2.75 per M.

The fires of 1910 killed all of the Western yellow pine transplants and most of the Western white pine, the seedbeds being unharmed. All buildings then on the site were wiped out.

The stock from the St. Regis Nursery was gradually disposed of by shipment to the field or to Stevens, and the former nursery was abandoned in 1911.

In the spring of 1912 the capacity of Savenac Nursery, as authorized by the Washington Office, was 3,500,000, this being reduced the following spring to 3,750,000 with the stock grown, proportioned as follows:

W. white pine----------	75.00%
W. yellow pine----------	22.50%
W. larch----------	1.50%
Engelmann spruce-------	.75%
W. red cedar----------	.25%
K. white pine----------	.25%
Total---	100.00%

Although authorized at a capacity of 3,750,000,

the output per year never reached that. In 1914, stock shipments amounted to only 1,560,000, and in 1915 a little better than 3,000,000.

These shortages were due chiefly to losses sustained in the seedbeds the first year.

The administration of the Savenac Nursery was transferred from the Lolo Forest to the District Office in the spring of 1915, and the writer, under the direction of the District Office, was placed in charge. This transfer was made "because of the increasing amount of specialized work involved in nursery practice, which should not properly tax the attention of a busy Supervisor, since the nursery is not essentially a part of the Forest organization."

With the assistance of Supervisor Koch and the rangers formerly employed at the nursery, it has been possible to advance the work with little or no lost motion resulting from the change, although it has, of course, been necessary for the writer to spend a great deal of time in the study of details this year, which will be unnecessary in the future. With these details now in hand, and the ditch and building improvements complete, opportunity will be afforded in another year to concentrate on numerous mechanical and administrative improvements which it has been previously impossible to consider, for lack of time.

A summary of the total expenditure of Planting

money for each Fiscal Year follows:

Fiscal year 1910 - - - $2,116.81

Fiscal year 1911 - - - $1,492.32

Fiscal year 1912 - - - $6,897.73

Fiscal year 1913 - - - $8,244.87

Fiscal year 1914 - - - $6,093.61

Fiscal year 1915 - - - $5,752.71

A considerable amount for ranger and guard labor was also expended up to the Fiscal Year 1915.

The amounts expended annually vary with the need for permanent improvements and the amount of stock to be sowed or transplanted to reach the authorized capacity.

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Fiscal year 1914 - - - $5,093.61

Fiscal year 1915 - - - $5,782.71

A considerable amount for ranger and guard labor was also expended up to the Fiscal Year 1915.

The amounts expended annually vary with the need for permanent improvements and the amount of stock to be sowed or transplanted to reach the authorized capacity.

CAPACITY.

At present there are 79,632 square feet of seed beds, or 1659 - 4' x 12' beds in the nursery. Including paths and odd corners the total area is 130,000 square feet, or about 3 acres. When germination is complete in all beds, the stand will be approximately 6,860,416. There are 1718 transplants in the field, covering about 5 acres. Allowing 3 acres for seedbeds and 2 acres for roads and ditches, leaves 22½ acres available for transplants. Transplants are left in the bed 2 years, so at 350,000 per acre, the transplant capacity is 4,000,000. Providing all stock shipped to the field were 2 year old transplants, an annual capacity of 4,000,000 would take up all available ground for trees, but since a large amount of seedling stock is shipped--at present about fifty per cent--ample ground is left for rotation of crops and summer fallowing. There is also extra ground for the nursery truck garden, and several acres of hay land. In the Fiscal Year 1917 the annual capacity will have reached 4,000,000.

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WATER SYSTEMS.

The Government has secured first water right on Savenac Creek. Four hundred and thirty-two miners' inches have been filed on. This amount is about the full flow of water in the creek during the dry summer season.

At present there is approximately one and one-half miles of ditch in use, nearly a mile of the old ditches having been abandoned, due to low pressure and insufficient volume of water obtained, and a new water system installed. The new system, mostly a mud-puddled ditch carried on the side hill, but flumed over the rocky points and slumping places with two-inch plank, is taken from the creek a little better than a mile from the nursery. It has a fall of six feet, resulting in an elevation of 104 feet at the settling box above the lowest seed bed area. This elevation gives a pressure of 45 pounds on the first bench. The settling box, holding 425 gallons, is not used as a reservoir, but serves as a means of straining and settling foreign matter and sediment carried down by the water. A 5-inch intake pipe taps the settling box at the bottom, and feeds the 4-inch main which extends through the main seed bed area to the nursery street. This 4-inch main sends out a 2½-inch main for supplying water on the middle bench.

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The seed beds on the third bench are watered from the ditch at that point, but when moved to the lower end of that bench the settling box can feed another main for these beds. There is sufficient volume flowing into the settling box to supply at least two 4-inch mains. The overflow is conducted down the face of the slope in a flume.

The laterals are all 1-inch pipe. The hose bibbs are so placed that with a 50-foot hose connection, the entire area can be easily covered. The ordinary solid round lawn sprinklers are used in watering the beds. The 4-inch main will keep thirty of these sprinklers at once, but for light sprinkling this would necessitate quite a crew of men to handle the sprinkling. Eleven sprinklers are all that one man can handle.

The overhead sprinkling systems were investigated and worked on this summer. No commercial system was found that would suit our needs, so one of our make was experimented with: 3/32-inch holes are drilled in alternating distances of 4 and 8 feet apart. Between the 8-foot aperture a hole 1/16 of an inch is drilled and hooded with a metal cap that spreads the stream into a fan-shaped spray. These sprays cover the first eight feet of seed beds, and the beds beyond that are sprinkled by the unobstructed streams. With our pressure, the water

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will cover 40 feet on each side of the pipe.

As planned, these pipes will run longitudinally with the beds, fed at either end of the area by a 2-inch lateral from the 4-inch main. The perforated pipe will be reduced from 1½ to 1 inch at the proper distance from each end, to maintain an even pressure, to the center of the area. The lateral feeds and main will be buried, to clear the surface of the ground from permanent piping, and the spraying pipes raised on 1-foot posts, so the streams will clear the seedlings, and keep the perforations from becoming clogged by being trampled on.

A sprinkling system of this kind will lessen costs considerably, for while one man is kept constantly at work watering the trees under the present system, under the overhead all that is needed is the turning on of the taps in the evening, and letting them run until the seedlings have received sufficient moisture. This will also enable us to sprinkle in the cool of the evening, instead of in the hot sun, which, although it has not been proven by experiments to have an ill effect, theoretically is injurious to the young growth.

At the lower end of the 4-inch main, are attached two 2-inch gate-valve taps. A few feet from these is a large reel containing 300 feet of 2-inch mill hose in 50-foot lengths, set in a hose house that can be turned about on a swivel and unreeled in any direction and coupled to

the taps. These 300 feet of hose will allow a play of two streams on all nursery buildings except the barn, and one stream on the two remote ranger dwellings.

The domestic system is furnished with water from the 4-inch main also, but since the water must be shut down in winter, and is often undesirable, due to standing in the pipes during the hot day, it is recommended that a small ram be installed for domestic purposes.

The transplant area is watered by irrigation. The system is not elaborate, since the upper bench has an even, gradual slope, and the location of ditches is apt to change as different arrangements of the transplants require.

NURSERY PRACTICE.

Seedlings.

Seedling stock will have to be depended upon to raise the capacity to 4,000,000 in the Fiscal Year 1917, and to maintain it for two years. Most of the stock originally sown for transplanting that does not appear too dense in the beds, will lie over next year, and then be shipped as seedling stock. (See Capacity Schedule).

Adding the area necessary for spring planting, exclusive of beds that will be taken up in the spring and resowed, a total of four acres will be needed for the seedling stand next year. While this additional acre of seed beds will cause no crowding of the land, yet it will necessitate putting out a large number of new beds on the third bench, which has several disadvantages, namely: Loss water pressure; more weeds, and distance from the center of material and equipment. However, if we continue to grow mostly seedling stock, arrangements can be made for a more systematic handling of the beds on the upper bench. The volume of water in the high ditch will be sufficient, but additional mains and settling boxes will have to be installed to supply what lacks in pressure on the third bench from the

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Adding the area necessary for spring planting, exclusive of beds that will be taken up in the spring and removed, a total of four acres will be needed for the seedling stand next year. While this additional acre of seed beds will cause no crowding of the land, yet it will necessitate putting out a large number of new beds on the third bench, which has several disadvantages, namely: Less water pressure; more weeds, and distance from the center of material and equipment. However, if we continue to grow mostly seedling stock, arrangements can be made for a more systematic handling of the beds on the upper bench. The volume of water in the high ditch will be sufficient, but additional mains and settling boxes will have to be installed to supply what lacks in pressure on the third bench from the

present main. The weeds will, of course, eventually be reduced to a minimum, and all beds on the third bench can be moved to the lower end, thus bringing them adjacent to the other seed bed areas.

1. Preparation.

In grouping the beds, consideration is given first to the time the stock is to be taken out. For example, we have one hundred spruce beds on one corner of the area which will be shipped in the spring. Alongside these are two hundred beds of 1-0 yellow pine, which will be shipped the following year as 2-0 seedlings. Yellow pine which is to be transplanted when one year old is planted in the old spruce plot, so that the two plots of yellow pine will come out at the same time. This will enable more ground to be plowed than if these two plots were separated by stocked seed beds, and in many cases, make it possible to cross plow the area, which is very beneficial to the physical improvement of the soil. Also, material and equipment, such as seed, sand and tools for resowing this area, need not be distributed between the two areas.

Second, consideration in grouping. Attention is given to the similarity of care and treatment of the stock. For example, in sowing the spruce, we find it has two alternatives under the first consideration, Eastern and Western white pine. It is sowed in a plot

present main. The weeds will, of course, eventually be reduced to a minimum, and all beds on the third bench can be moved to the lower end, thus bringing them adjacent to the other seed bed areas.

1. Preperation.

In grouping the beds, consideration is given first to the time the stock is to be taken out. For example, we have one hundred spruce beds on one corner of the area which will be shipped in the spring. Alongside these are two hundred beds of 1-0 yellow pine, which will be shipped the following year as 2-0 seedlings. Yellow pine which is to be transplanted when one year old is planted in the old spruce plot, so that the two plots of yellow pine will come out at the same time. This will enable more ground to be plowed than if these two plots were separated by stocked seed beds, and in many cases, make it possible to cross plow the area, which is very beneficial to the physical improvement of the soil. Also, material and equipment, such as seed, sand and tools for reseeding this area, need not be distributed between the two areas.

Second, consideration in grouping. Attention is given to the similarity of care and treatment of the stock. For example, in sowing the spruce, we find it has two alternatives under the first consideration, Eastern and Western white pine. It is sowed in a plot

adjoining the Western white pine, because both require shading during the summer, and thus the two plots may be handled as one. A few odd beds above or below the Capacity Schedule requirements are omitted or left blank. All new experimental beds will be put in the new experimental area on the third bench, so as not to interfere with a systematic arrangement of the beds.

After plowing, the ground is thoroughly harrowed with a spring-tooth harrow, and, if necessary, further levelled and pulverized with a float. The beds are then marked off with string, four feet wide and forty-eight feet long, with two-foot paths between. When commercial fertilizer is used, it is applied at this stage of the bed-making. It is applied by hand, and then worked into the soil with rakes. When horse-manure is used, it is worked into the ground by the first plowing. The beds are raised slightly by shoveling dirt from the paths, then carefully raked and levelled by hand. During this last operation, stones, roots, sod and hard lumps of dirt are scraped back into the path and later wheeled away. A final smoothing of the bed is done with a board about two feet long, manipulated on edge with one hand, to pulverize all lumps of dirt and make the surface free from small cavities that seed are apt to drop into.

2. Fertilizers.

The most suitable fertilizer for forest nurseries is a question of the greatest importance.

Analysis of two samples of soil from Savenac Nursery, made by the Bureau of Soils in 1913, shows the following results:

Savenac Nursery.

	From Seed Beds.	From Transplant Area.
Sample No.	I.	II.
Per cent C O	.88	.54
" " P_2O_5	.18	.30
" " K_2O	.51	.24
" " N	.09	.14

Up to 1914, horse manure was used at Savenac Nursery with satisfying results as far as a more luxuriant growth of the stock was concerned, but manure brought a large amount of grass-seed into the beds. Applications of lime, bone meal, and swamp muck were tried, but there was no apparent difference between the fertilized and the check beds. From the results obtained with horse manure, it was believed that the soil lacked sufficient nitrogen. In 1914 a dressing of dried blood and bone meal was tried. A report of that year states: "The use of fertilizer (blood and bone) has made a tremendous

difference in the thrift and uniformity of the stock." For a while, an application for the chemical improvement of the soil seemed quite solved, but this year complications have set in. All spring sown beds were given a dressing of two pounds dry blood and one pound bone meal, to forty-eight square feet. Beds were left to check the results. In general, the fertilized stock has a rich, dark color, and appears more thrifty than the yellow-green spindly, non-fertilized stock. On close examination, the crown is found to be larger in the treated beds. Of the 107 beds sowed for yellow pine transplant stock, the four check beds have the thickest stand. This, however, may have no bearing on the fertilizer.

This summer, the white pine beds were infected with a disease termed "Purple Top" by the Consulting Forest Pathologist of this District. All of this area, excepting one row of experimental beds lying adjacent, had been dressed with blood and bone meal when sowed. as far as we have been able to ascertain, the fertilizer in the main block of stock, and not in the experimental beds, was the only difference in the care and treatment between the two. Yet, while the experimental row had only one dead tree at the most per forty-eight square feet, due to the "Purple Top" disease, the beds adjacent were literally brown with dead seedlings. This fact, and

the fact that detailed notes in comparison between the fertilized and non-fertilized stock set out on experimental plantations, showed less survival (although greater average growth in the fertilized stock) led me to believe that this commercial fertilizer predisposes the stock to fungous attacks. Most authorities on the subject will agree that, in order to obtain the best results from nursery stock planted in the field, it must be grown in as near like condition at the nursery as nature would have it propagated under its parent tree. Yet we are coaxing along the stock with a stimulus, as the grower does the hothouse rose, resulting in a weakened plant organism, and expect it to better survive all competition in the field than stock trained for field planting.

Data on these two classes of stock planted in the field is little, but it is hoped more will be obtained so that we can draw definite conclusions. What may give satisfying results in the nursery end of forest extension may have its ill-effect in the field. It is survival in the field that we want, and the cost of tree production at the nursery is, in many cases, less than the cost of actually setting the trees in the plantation.

An elaborate set of checks on blood and bone meal fertilizer was started this fall at the nursery. This stock will be watched closely in the field, from which,

it it believed, conclusive results can be obtained, to ascertain just what effect the commercial fertilizer has on the planted trees. Experiments with other fertilizers will be renewed in the spring.

3. Sowing.

All coniferous seed is sowed broadcast. The desired amount of seed for forty-eight square feet is weighed in a postal scale, and placed in pails set 12 feet apart in the row of beds. This unit will help to more accurately gauge even sowing than if the sower had to handle large quantities of seed for larger areas.

The sower walks down one side of the row of beds, casting the seed from the path to the center in quarter-circular sweeps. He does not hop over the row and finish the twelve-foot bed before he starts sowing another, but sets down the pail and picks up the next, and so on, until the of beds is finished on the one side, then comes up on the other. The foreman generally weighs and sows the seed.

Following is a table showing amount of seed sowed per forty-eight square feet in 1915:

Amount of Seed to Sow per 12-foot Bed.

Species	Seed per Pound	Exp. Sta. Germ. Test	Class of Stock	Amount Sown	Expected Stand
P. monticola	25,197	45%	Seedling	10 ozs.	7,500
			Transplant	1 lb.	12,000
P. strobus	29,274	60%	Seedling	7 ozs.	7,500
			Transplant	1-¼ lb.*)	14,000
Picea Engelmanni	140,500	83%	Seedling	.6 ozs.	4,500
			Transplant	1.7 "	12,000
P. ponderosa	-old	seed -	Seedling	17 "	3,000
			Transplant	2-3/8 lb	6,500

*)Relatively large. Not to be left in the beds for the second year germination.

Age of Seedling Stock When Transplanted.

Species	Age
P. monticola	1&2-0
P. strobus	1-0 - (When large per cent of germination holds over 1&2-0.
Picea Engelmanni	2-0
P. ponderosa	1-0

Age of Seedling Stock When Shipped.

Species	Age
P. monticola	2&3-0
P. strobus	2&3-0
Picea Engelmanni	3-0
P. ponderosa	2-0

Amount of Seed to Sow per 1/5-foot Bed.

Species	Seed per Pound	Germ. Sta. of Stock	Close of Bloom	Amount Sown	Expected Stand
P. montioola	26,197	48%	Seeding	10 ozs.	7,500
			Transplant	1 lb.	12,000
P. strobus	29,274	60%	Seeding	7 ozs.	7,500
			Transplant	1-½ lb.*)	14,000
Pinus Mugel-lus	140,800	88%	Seeding	6 ozs.	6,500
			Transplant	1.7 "	12,000
P. ponderosa	-old-	seed -	Seeding	17 "	3,000
			Transplant	3-3/0 lb.	6,500

*)Relatively large. Not to be left in the beds for the second year germination.

Age of Seedling Stock When Trans lanted.

Species	Age
P. montioola	1-0
P. strobus	1-0 - (When large per cent of germination holds over 1-0.
Pinus Mugelhumnt	1-0
P. ponderosa	1-0

Age of Seedling Stock When Shipped.

Species	Age
P. montioola	2-0
P. strobus	2-0
Pinus Mugelhumnt	1-0
P. ponderosa	1-0

The ideal amount of stock to grow per bed is being worked out in nursery experiments. Pending final conclusions, densities shown in table on page 18 are representative, in my best judgment, of the amount to sow per forty-eight square feet.

After sowing, the seed is covered with fine river sand. The sand is carted along the paths in wheelbarrows and distributed as evenly as possible with a shovel. It is then levelled off with a straight-edged board about two feet long, manipulated by one man, very much the same as in levelling the surface of a newly laid cement walk. Formerly the sand was firmly packed with a tamper, but this fall a water-weighted roller, fifty-two inches wide, was tried out, which not only reduced the cost of the operation many hundred per cent, but also packed the sand more uniformly. It is necessary for our light soil, that this roller be at least two feet in diameter, to avoid a rippling effect on the surface of the beds.

4. Depth of Covering.

Numerous experiments at the nursery show that the depth of sand cover is vital to the germination of the seed. In the table following are some of the results obtained from experiments of the depth of sand cover. It is believed that uneven density in the beds is due more to uneven depth of covering than to uneven sowing. Just what covering will give best results can be determined only by experiments.

The ideal amount of stock to grow per bed is being worked out in nursery experiments. Pending final conclusions, densities shown in table on page 18 are representative, in my best judgment, of the amount to sow per forty-eight square feet.

After sowing, the seed is covered with fine river sand. The sand is carted along the paths in wheel-barrows and distributed as evenly as possible with a shovel. It is then levelled off with a straight-edged board about two feet long, manipulated by one man, very much the same as in levelling the surface of a newly laid cement walk. Formerly the sand was firmly packed with a tamper, but this fall a water-weighted roller, fifty-two inches wide, was tried out, which not only reduced the cost of the operation many hundred per cent, but also packed the sand more uniformly. It is necessary for our light soil, that this roller be at least two feet in diameter, to avoid a rippling effect on the surface of the beds.

4. Depth of Covering.

Numerous experiments at the nursery show that the depth of sand cover is vital to the germination of the seed. In the table following are some of the results obtained from experiments of the depth of sand cover. It is believed that uneven density in the beds is due more to uneven depth of covering than to uneven sowing. Just what covering will give best results can be determined only by experiments.

Four beds at Savenac Nursery were sown to determine the proper depth of cover, in May, 1914, two broadcasted and two in drills. Each bed contained plots of Western white pine seed covered with 1/4", 3/8", 1/2", 5/8", and 3/4" of sand. Each plot was sown with a uniform quantity of seed.

Current records were made from time of sowing until August 1, 1915, when germination was complete, and the season's loss appeared likewise to have taken place. Survival counts August 1, 1915, gave these results:

	Depth of Cover.					
Method	1/4"	3/8"	1/2"	5/8"	3/4"	No.of Plots Ave.is Based on
Ave. Drills	379	309	206	166	107	2
Ave. Broadcast	610	544	363	243	175	2
Ave. Both	494	426	284	204	141	4
Per cent of No. surviving at 1/4"	100%	86.2%	57.5%	41.3%	28.5%	4

The total recorded damping-off loss up to August 1, 1915, was:

Method	1/4"	3/8"	1/2"	5/8"	3/4"	No.of Plots Ave.is Based on
Average both methods	186	176	187	184	192	4
Per cent of total germination lost through damping off	25.7%	26.9%	37.0%	45.0%	55.7%	4

Four beds at Sevenoaks Nursery were sown to determine the proper depth of cover, in May, 1914, two broadcasted and two in drills. Each bed contained plots of Western White pine seed covered with 1/4", 3/8", 1/2", 5/8", and 3/4" of sand. Each plot was sown with a uniform quantity of seed.

Current records were made from time of sowing until August 1, 1915, when germination was complete, and the season's loss appeared likewise to have taken place. Survival counts August 1, 1915, gave these results:

Depth of Cover.

Method	1/4"	3/8"	1/2"	5/8"	3/4"	No. of Plots Averaged
Ave. Drills	279	309	306	166	107	2
Ave. Broadcast	810	844	363	248	178	2
Ave. Both	454	466	284	204	141	4
Per cent of No. surviving at 1"	100%	86.2%	87.6%	41.8%	28.8%	4

The total recorded damping-off loss up to August 1, 1915, was:

Method	1/4"	3/8"	1/2"	5/8"	3/4"	Ave. No. of Plots Averaged
Average both methods	156	176	187	164	139	4
Per cent of total germination lost through damping off	26.7%	26.9%	37.0%	45.0%	55.7%	4

From the data obtained, it is concluded that:

1. One-fourth inch is the optimum depth for sand cover on Western white pine beds, combining:

(a) highest rate of germination,

(b) lowest relative loss from damping-off, and from all causes combined,

(c) highest relative survival.

2. Under the conditions of this test, one pound of seed will produce as many plants under 1/4" cover, as 1-1/7 pounds under 3/8" cover, or nearly 2 pounds at 1/2" in depth.

3. Absolute prevention of damping-off, while it would be relatively advantageous to the deeper sown seed, would not prevent a heavy waste with deep cover. The theoretical survival, had there been no loss from damping-off, would stand thus:

	(Actual Average Survival)	-	(Average Loss from Damping-off)	=	(Average Theoretical Survival (Damping-off Eliminated)
1/4"	494	-	186	=	680
3/8"	426	-	176	=	602
1/2"	284	-	187	=	471
5/8"	204	-	184	=	388
3/4"	141	-	192	=	333

3/4"	141	-	128	=	328
5/8"	204	-	184	=	288
1/2"	284	-	187	=	471
3/8"	426	-	176	=	602
1/4"	494	-	186	=	880

4. The economy in both cover material and labor with 1/4" sand cover is apparent.

5. It appears, however, that shallow covering is likewise more favorable to weed-growth.

6. It is impossible to obtain a uniform density with this species without uniformity in depth of cover, no matter how evenly the seed may be distributed over the sowing surface.

The seed contains chiefly food stored up for the use of its embryo, as soon as germination sets in. No food is manufactured by the young plant until it pierces the surface of the soil, when the light enables the plant to carry on photosynthesis. Therefore, if the sand covering is of such depth that the embryo has used up this stored food, it will die of starvation, as it were. It might be pointed out here, that when we speak of those above the ground as representing germination, we are partially in error, for many may have died after germination, but before they reached the surface.

Means and devices for securing a uniform depth over the beds have been worked on, but up to the present time, with no satisfying results. Since the surface of an individual bed may be curved or rolling, a frame for gauging the cover cannot be set economically to conform to these irregularities of the surface.

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Until a means for regulating this depth of cover has been solved, the old method of just guessing will have to be followed, although the irregularities may be somewhat modified by more painstaking in the operation.

5. Acid Treatment.

Within twenty-four hours after sowing, all beds, excepting those left to check results, are given the sulphuric acid treatment recommended by Carl Hartley--- 3/16 fluid ounces of acid, diluted in 3/16 gallons of water, applied to the square foot. Two days after the acid treatment, the beds are given a thorough sprinkling to wash the fungicide well down in the soil.

We are having difficulty in securing a sprinkling can that will not be eaten by the acid so rapidly. The rose will last about four hours of continuous use, and then must be replaced with another. The rest of the can remains intact with this usage, but must be abandoned because of the eaten spout. A paraffin coating on the can has been tried, but it does not check the reaction of the acid on the zinc enough to warrant this extra precaution. Attempts will be made to secure sprinklers made of granite ware, glass or wood, for applying the acid.

The acid is bought in carboys, at a price ranging from 4 cents to 5 cents per pound. It is believed that this cost can be reduced to about 2 cents by purchasing it in large drums containing about 1,000 pounds. All acid is

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6. Season of Sowing.

For the fine seeded specimens, such as larch and spruce, spring sowing is entirely satisfactory, and we have had no trouble with seed holding over for a year, The sowing, however, should be done early, provided the ground is dry enough to work well, usually about the latter part of April. This applies to all species for spring sowing.

Yellow pine has been sown in the spring, but this seed is showing a tendency to partly hold over its germination until the last month or two of the growing season. This late germination in transplant stock is not noticeable, although it may have its ill effect in winter killing or the shock sustained by transplanting, but in raising 2-0 stock, the seedlings of fall germination are so inferior that it is necessary to cull them out when the stock is taken up. About 25% of the 2-0 yellow pine stock taken up this fall was discarded for this reason. Fall sowed experimental beds of this class of stock, show thrifty stock of even age.

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The question of germinating Western white pine in one year has not been solved. Early fall sowing of this species is practised.

Eastern white pine seems to vary in its tendency to all germinate the first year. While total germination the first year can generally be depended upon if the seed are soaked in water several days before sowing, still, seed from a different lot may hold over as in Western white pine. Seed purchased from the Northeast Forestry Company all germinated the first year. Seed from Meehan & Sons, treated exactly like the other lot here at the nursery, held about 50% of its germination over to the second year. It is believed that this irregularity can be avoided by fall sowing of Eastern white pine.

The sowing and care of the seed beds are under direct supervision of Assistant Forest Ranger W. F. Simons, who has spent four years at the nursery, and is a thoroughly competent man. He is given work six months out of the year and a government house at the nursery, where he resides the year round. If possible, he should be transferred to a small nursery, on which there is work for him year-long.

The following is a good unit working crew for actual sowing and covering of the seed beds:

2 men to wheel and spread sand,
1 man (foreman) to weigh and sow seed,
2 men to level off sand and roll beds.

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2 men to level off sand and roll beds.

This crew of five men can sow and cover 200 12-foot beds per day. The same crew can prepare for sowing, 150 beds per day.

7. Shading.

Both the nursery experiments and general practice in the nursery have shown conclusively that shade is unnecessary for yellow pine, but advantageous for Western white pine, cedar and spruce. Western white pine and spruce are given one-half shade, and cedar, three fourths. Since the twelve-foot bed has been abandoned and the longer beds substituted, it will be more convenient and cheaper to use woven lath that can be rolled up, than the present 4 x 12 shade frames.

More care should be exercised in placing, and particularly in removing artificial shade. I believe that considerable loss is sustained from sun scorch by removing the shade from the seedlings on a bright day. By selecting a cloudy day for this, or removing the shade for only a few hours at a time - in the morning - to gradually accustom the trees to full light, loss from this cause will be reduced.

8. Cultivation and Weeding.

No cultivation is advisable for broadcast beds. Weeding should be a continuous operation, and the beds kept clean. The thicker and more uniform the seedling stand, the less weeding will be required. All weeding in the beds is done by hand and should be done often enough to get the weeds

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when they are small, so as not to disturb the seedlings. An early start at the weeds will mean a great saving in this phase of the work. Last year the transplants and seedlings were neglected for several weeks during the construction of the new water-ditch. The spring, being an unusually wet one, brought out a rank abundance of weeds. As a result the weeds had the upper hand the entire season, even though five men were at work all summer, endeavoring to catch up on the weeding and cultivation. A check on this statement is shown by the fact that I started on a block of 50 48-foot yellow pine beds as soon as weeds began to appear. This area was cleaned of all weeds in less than an hour once a week.

A special effort should be made to keep the timothy, clover and weeds along the ditches mowed down before they go to seed, as the ditches carry large amounts of seed into the nursery.

A riddance of weed and grass along the borders of the area and in the path, not only lessens the source from which foreign seed may be carried into the planted areas, but gives a clean-cut appearance to the beds and transplant rows. An edging of tall grass within a foot of the stands impresses one as a garden cut out of the jungles.

For weeding the paths in the seed beds eleven-inch, one sided sweeps of the Planet Junior hand tools were tried out this summer and found to be very satisfactory.

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9. Watering.

The amount of water applied to the seed beds has been left largely to the judgment of the nurseryman, Simons, and I believe he has used excellent judgment. The experiments which have been made in watering have given rather inconclusive results, except that heavy watering at long intervals does not seem to be as efficient as more frequent watering.

Watering is particularly important during the germination period. It must be kept in mind that water is necessary to initiate germination. In the period following this up to the time when the sprouting of the seed actually occurs, the seed is in its most delicate condition, and most subject to serious harm or loss of entire vitality from drying out. When germinative activities are once started they should not be checked thru the lack of one of the most primary requisites, water. Light and frequent sprinkling is given to the germinating beds, and heavier and less frequent water given to the beds that have completed germination.

10. Injuries to Seedling Stock.

Diseases: During the latter part of April, 1915, the attention of the Office of Investigations in Forest Pathology was called to a rust that had broken out on the stems of 2-0 yellow pine. Shipments to field plantations were held subject to inspection. The seedlings were found

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to be infected with the yellow blister rust, Peredermium filamentosum. All of the 2-0 yellow pine was inspected, and the visibly infected seedlings - about 4 per cent - culled and burned. A thorough examination of the territory surrounding the beds revealed a large patch of Castilleia miniata growing on the edge of a lodgepole pine stand near the creek bank, directly northeast of the infected seedling beds, and not more than 200 feet distant. The records of the weather station here show that the prevailing winds blow northeast and southwest, which is an important factor in spore distribution between the two hosts. These winds sweep northeast from the 2-0 yellow pine beds over the Castilleia patch, and in reversing, blow southwest from the Castilleia area to the seedling beds. In this manner the aeciospores from the infected yellow pine are distributed to the Castilleia plants and the sporidia borne on the Castilleia leaves are transmitted to the young trees in the beds.

The scare from the Peridermium infection had hardly subsided, when a seemingly more serious disease appeared on both the 2-0 yellow pine and Western white pine seedlings. The seedlings were affected with a dying of the tops or "Purple Top." The heaviest infection appeared in the beds on the west border of the grounds, where the soil conditions are the more moist, and decreased in the beds to the east, being only 15 per cent fatal in

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some of the drier beds. Investigations showed that 30 per cent of the seedlings were actually dying from this cause, and since this involved the loss of a large amount of seedlings, it became apparent that some method or methods of prevention should be introduced. The District Pathologist at this time kindly agreed to cooperate with us and the control of all nursery diseases in the District has been put under his supervision. A 4-4-50 soap Bordeaux mixture was decided upon as best serving the purpose on all the younger 1-0 seedlings, and a 5-5-50 soap Bordeaux recommended for the older and hardier seedlings. All infected plants were removed and burned. Experiments are under way to determine the exact cause of the "Purple Top" of these seedlings.

The heavy rains of the spring caused considerable loss of Western white pine due to damping-off. I do not know whether the acid treatment of these beds, when sowed, was effective or not. No treatment was given after germination.

Rodents: Rodents gave us no trouble until this fall, when they attacked some of the new fall-sowed beds on the third bench. Poisoned wheat proved ineffective, but a shotgun and a few traps rid the area of chipmunks. Mice are kept down by the nursery force of cats, now numbering ten.

Birds: Screen frames are used for protection against birds, but at no time are all germinating beds protected from them. In the past, birds have been a nuisance around the seed beds. The red poll linnets would come in large flocks and raid the newly sowed beds. When scared from one block of beds, they would fly to another. A boy was kept during most of the growing season to scare them away, but the birds could not be kept from doing considerable damage. The federal law does not permit killing the birds. This year, for some unknown reason, birds gave no trouble whatever.

Screen frames serve only as a precaution to the attacks of the birds. If these screens can be be abandoned a great saving will be made, not only in the cost of the screens, but also the large amount of handling that is necessary in their use. To cover all the beds with screen would mean a total investment of $5,000. The question would be solved if a permit could be gotten from the state game warden to shoot these birds.

Other losses: A number of two-year old pine beds were sun scorched last summer.

It is estimated that $100 worth of damage was done to the new fall sowed white pine beds, when a stray horse got into the nursery one night, and made a race course of part of the newly sowed area. There has not been a year in the life of the Savenac Nursery that some

horse or cow has not gotten into the nursery and trampled down the beds. They generally gain entrance through some gate left open during the night. Self-closing gates will probably put an end to this source of damage.

11. Mulching.

It is clearly unnecessary to mulch yellow pine or second year white pine beds. First year white pine beds, where the seedling stand is scattered and germination has continued late should be mulched. One-year-old spruce should also be mulched. Oat straw is used for mulching, since it is the only cheap available material for that purpose. Straw brings in quite a lot of grass seed, but it cannot be avoided. Care should be taken that chaff, which causes heating and mold in spots, be discarded. Six pounds if straw are used per 12-foot bed. Several beds were mulched this fall with excelsior and burlap, to get a check on heating, winter killing and introduction of weeds in the straw mulched beds.

If a heavy snow comes early in the fall before much freezing, it is better to wait until the changing warm and cold days of spring set in, before mulching.

12. Marking the Beds.

The seed beds are numbered with markers made of twenty-gauge galvanized sheet iron. The number plate is

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3" x 4½". The standard is 1"x 12", folded on both edges to give rigidity, and soldered to the number plates.

All plots of stock, both transplants and seedlings, are fully described on the "Simons Seed Bed Marker"- (see blue print). On the card inserted in this marker for seedling stock is given:

1. Corner plot and number of beds,
2. Species,
3. Source of seed,
4. Date of sowing,
5. Amount of seed per bed,
6. Care and treatment.

Marking transplants: Transplants are marked to show:

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2. Species,
3. Source of seed,
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Transplanting.

1. System.

In the fall of 1913, an attempt was made to introduce the Taylor System of Scientific Management into the nursery. From a close study of Taylor's "Shop Management" and similar works, the Planting force became convinced that in nursery work, as in no other work in the Service, the methods therein outlined and results obtained were possible to a high degree. These methods are in brief:-

"1. A science for each element of the work.
2. Careful selection, training, teaching and developing of employees.
3. Cooperation on part of management and employees.
4. Equal division of work and responsibility. Management takes over all work for which it is better fitted."

(Taylor's "Shop Management")

5. Implied, but not actually expressed in the above, is a cardinal principle underlying the whole Taylor System that, aside from the fact that each man be carefully selected, carefully taught and trained, and finally set at work for which he is best fitted, he be paid according to his individual work.

The initial attack on the old Rule of Thumb methods was made in transplanting. After a thorough study of the detail operations and the project as a whole, methods as outlined in the following treatise were adopted. Changes in the new method have been made

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In the fall of 1915, an attempt was made to introduce the Taylor System of Scientific Management into the nursery. From a close study of Taylor's "Shop Management" and similar works, the Planting force became convinced that in nursery work, as in no other work in the Service, the methods therein outlined and results obtained were possible to a high degree. These methods are in brief:-

"1. A science for each element of the work.
2. Careful selection, training, teaching and developing of employees.
3. Cooperation on part of management and employees.
4. Equal division of work and responsibility. Management takes over all work for which it is better fitted."

(Taylor's "Shop Management")

5. Implied, but not actually expressed in the above, is a cardinal principle underlying the whole Taylor System that, aside from the fact that each man be carefully selected, carefully taught and trained, and finally set at work for which he is best fitted, he be paid according to his individual work.

The initial attack on the old Rule of Thumb methods was made in transplanting. After a thorough study of the detail operations and the project as a whole, methods as outlined in the following treatise were adopted. Changes in the new method have been made

from time to time to conform to prevailing conditions, but the principle upon which the system is based is unchanged and has shown gratifying results. New methods adopted at the Savenac Nursery are termed "Forest Service Methods", abbreviated "F. S."

2. Season.

All stock is transplanted in the spring, fall planting having been abandoned because of frost heaving. Transplanting is always a rush job as it must be done before the stock starts its season's growth. Last spring the work was started April 15 and completed May 11. It is believed that the transplant season may be lengthened by keeping the seedling stock to be transplanted, in cold storage.

3. Preparation of the Ground.

Rotation of crops on our transplant ground has been somewhat irregular. While after a harvest of trees, the ground is generally sowed to a green fertilizer or is summer fallowed, or both, the practice has not been systematized so that all ground is treated alike. The main reason for this is that the different blocks of transplants are scattered instead of being grouped in the field.

If the ground is not summer fallowed, it is plowed and cross-plowed in the fall. At least a week before transplanting, it is plowed again, harrowed and

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If the ground is not summer fallowed, it is plowed and cross-plowed in the fall. At least a week before transplanting, it is plowed again, harrowed and

leveled. Whenever the land is worked, all roots, rocks and rubbish are picked up and hauled away.

The best means for irrigating the transplants should be well studied out before the work starts.

4. Methods.

The length of the row is dependent upon the number of unit crews. It has been found from time studies that 10 boards is the maximum amount one crew should plant to the row, for the additional time required for the planter to walk to plant farther than this from the threading table, is greater than is required to stop operations and move the tables back.

Trenching.

The V-shaped trench, aside from costing about 15 cents per M., was a man-killing job. Also in the old trench, it was next to impossible to get the roots properly adjusted, many of them failing to hang vertically in the trench.

The aim in the "F. S. Method" was to get a horse-drawn implement to make an open trench.

The smallest sized one-horse plow obtainable was secured in Spokane, an eight-inch (depth of trench) landside placed on it, and the mole board cut off at the back, so that it would not throw the dirt so far.

It works admirably. The rows are made seven

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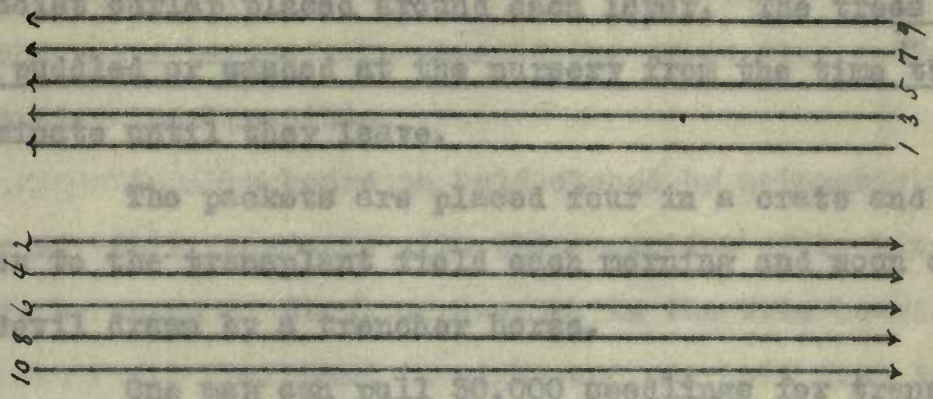
inches apart, five rows to the bed. Two feet are left between the beds for irrigation laterals. The order in which the trenched rows are made is shown by the arrows on the following diagram:



Immediately after making a round trip with the plow, the plowman takes a hoe having a blade two feet wide, and cleans the trenches of loose dirt that has fallen back, and rocks, and straightens out any bad crooks in the row. The trench is now ready for planting.

Threading.

The stock to be transplanted is taken up by men selected for that work, men whom we feel can do that work better than any other on the nursery force. Speed in transplanting is partly due to their class of work. The seedlings are lifted with spading forks, estimated in bunches of seventy-five, the dirt shaken from the roots, moderately pruned with a small butcher's cleaver, and then placed in seedling packets.

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Transplanting.

The stock to be transplanted is taken up by men selected for that work, men whom we feel can do that work better than any other on the nursery force. Speed in transplanting is partly due to their class of work. The seedlings are lifted with spading forks, estimated in bunches of seventy-five, the dirt shaken from the roots, moderately pruned with a small butcher's cleaver, and then placed in seedling pockets.

Packets: These packets are long, narrow boxes that will hold fifty bunches in two layers. The bunches are separated by long finishing nails driven into the center of the box and protected from drying out by strips of moist burlap placed around each layer. The trees are not puddled or washed at the nursery from the time they germinate until they leave.

The packets are placed four in a crate and taken to the transplant field each morning and noon on a go-devil drawn by a trencher horse.

One man can pull 30,000 seedlings for transplanting per day. This includes digging, bunching, pruning and packing.

Threading Tables: The threading tables are completely covered with canvas. This is necessary, because of the strong wind during the afternoon which would otherwise bother the threaders. Arrangements, however, are made for ventilation. (For details of the table, see photographs).

Planting Board: (See blueprint) The Forest Service planting board is changed in several respects from the Yale board:

1. The principle of holding the seedlings by pressure on the stem rather than on the crown, resulting in no loss from dropping out of seedlings.

Baskets: These packets are long, narrow boxes that will hold fifty bunches in two layers. The bunches are separated by long finishing nails driven into the center of the box and protected from drying out by strips of moist burlap placed around each layer. The trees are not pudded or washed at the nursery from the time they germinate until they leave.

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Planting Board: (See blueprint) The Forest Service planting board is changed in several respects from the Yale board:

1. The principle of holding the seedlings by pressure on the stem rather than on the crown, resulting in no loss from dropping out of seedlings.

2. The wood containing notches replaced by a removable galvanized iron strip. This was primarily done to give greater strength in small space by means of the iron , so that the base and clamp of the board could come closer together, allowing the dirt to be pushed in closer to the upper part of the stem of the plant than would have otherwise been possible.

3. The board is held closed by automatic spring clamps. This does away with the operation of locking the board by means of thumb screws, as in the Yale board.

4. The board is eight and one-half feet long instead of eight feet, and holds seventy plants as compared to sixty-four, resulting in a spacing of one and one-third inches. The number of notches in the board was arrived at by time studies showing the time it took to thread and plant a board. With this number per board, neither threader nor planter is kept waiting for the other.

5. Iron spikes are fastened to the board, so that when set on the edge of the open trench, it will stay in that position while the dirt is being tamped around it.

Threading: <u>There is only one threader to each unit crew.</u>

The threader pulls the empty board, which has been placed on the table with the wings open by the planter, toward him with his right hand, and grabs a

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Threading: <u>There is only one threader to each unit crew.</u>

The threader pulls the empty board, which has been placed on the table with the wings open, by the planter, toward him with his right hand, and grabs a

bunch of seedlings from the packet which is suspended from the table before him, with the other hand, and starts threading. The trees are worked forward with the fingers of the left hand and placed in the board with the right. Poor trees are culled if seen before they are dropped in the board. If not, a good tree is placed in the notch with the poor one. When the board is finished it is closed and pushed down the trap slide with one hand, in one movement, ready for the planter. The empty board again before him is drawn forward with the same hand and threading of the new board begun, etc., etc.

Only two boards are used per crew.

Planting.

There is only one planter to each unit crew.

The planter, after placing the empty board on the table, grabs the full one just threaded and walks out to the trench. He faces the land side of the trench, sets the board on the edge of the land side, tilting it slightly backward, then grabs the "planter's rake" and scrapes the loose dirt against the board, packing the dirt firmly as he walks along the board. Then he walks back one foot on each side of the board. Dropping the rake in readiness for the next board, he grabs one wing of the board with each hand, opens and lifts up the board and carries it to the table.

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Tallying.

Each planter has the ends of his area of ten board length rows marked with a red flag. If Crew No.1 has finished his row and Crew No.2 lacks two boards of having his finished, planter No. 1 will plant one board in Crew No.2's territory and place a florist pot stake with his crew number, at the end of that extra planted board. Thus each evening, by counting the rows, multiplying by ten, and subtracting or adding extra boards planted as shown by these stakes, an absolute "no cheat on system" for counting the output of each crew is made. This system was adopted this year. Previously a tally register automatically registered each board as it slid from the table, but the threader could boost this device if he chose.

As a result of the system, - principally the adoption of a sliding wage scale and the perfection of a cheat proof means for tallying the output of the crews - transplanting works automatically. in the future the foreman will spend most of his time in preparing the irrigation system for the newly transplanted area. Actual supervision of the crews will be small, only an occasional inspection of the planting being necessary.

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The Transplant Crew - 1915

Olson - in Charge of Nursery

Foreman

Supervision Laying out Beds.	Grinding Plow. Irrigating.*		Moving Tables Seeing to Repairs.	
Plowman. Drives plow horse. Cleans trenches. Moves tables. Tends plants. Carries water.	Crew #1. Threader. Planter.	Crew #2. Threader. Planter.	Crew #3. Threader. Planter.	Crew #4. Threader. Planter.

*The foreman makes the irrigation laterals in the center of the 2' space between beds, as each bed is planted.

The Transplant Crew - 1918

Olson - in Charge of Nursery

:
:
:

Foreman

Supervision	Grinding Plow.	Moving Tables
Laying out Beds.	Irrigating. *	Seeing to Repairs.
:	:	:
:	:	:
:	:	:
Plowman. Drives	Crew #1. Crew #2.	Crew #3. Crew #4.
plow horse.	Threader. Threader.	Threader. Threader.
Cleans trenches.	Planter. Planter.	Planter. Planter.
Moves tables.		
Tends plants.		
Carries water.		

*The foreman makes the irrigation laterals in the center of the 2' space between beds, as each bed is planted.

The threaders and planters are paid on a sliding wage scale. The following is the scale used last spring. Each spring before this scale is used, various men on the nursery force are tried out and those best suited for the work are chosen. Generally the young fellow makes the best threader - girls would be better - and the short, husky man the best planter.

Wage Scale
Spring 1915.

Boards* per Hour	Rate per Day
36	$2.75
37	2.85
38	2.90
39	2.95
40	2.95
41	3.00
42	3.05
43	3.10
44	3.15
45	3.20
46	3.25
47	3.30
48	3.35
49	3.40
50	3.45

*Seventy-five plants per board.

Each morning the threader and planter are given the time sheet of the work done the previous day. This not only serves as a means for them of keeping track of their earnings, but tends toward competitive interest between the crews.

Daily Time Sheet	
Date ________	Men ________
Proj. ________	Op.° ________
A.M. ______ Eff.Hr.‡ ______	Cr.Outp.* ______
P.M. ______ Eff.Hr. ______	Cr. Outp.* ______
Remarks	
Foreman ____________	

° Whether threading or planting.
* Boards per hour.
‡ Hours worked.

Under normal conditions on a 2,000,000 job, the crews will average 40 boards per hour each, or 12,000 trees per man (24,000 per crew) per day.

In the spring of 1914 the record was reached by this method, when for two hours one crew planted at the rate of sixty-four boards per hour.

Following is a daily record of the output of each crew for the spring transplanting of 1915:

5. Cultivation and Weeding.

The transplants are cultivated and weeded at least twice a year. Cultivating is done with the Planet Junior hand cultivator. While the Planet Junior takes care of most of the weeds, those between the trees in the row are pulled by hand. This last-mentioned operation is made very thorough in stock that is to be taken up in the fall, when the transplants are gone over for the last time of the season, because, if left, the weeds between the plants become a great hindrance to fast work in pulling and counting the stock.

6. Watering.

All transplants are watered by furrowed irrigation. The main feed and waste ditches are made with the transplant plow. Laterals between each bed are made by hand hoes and shovels. I believe that an irrigation plow attachment for the hand cultivator can be secured that will give satisfactory results and make the work lighter.

During dry weather, the stock is thoroughly watered about once every five days. All irrigating is done during the night, the water being turned onto a plot in the evening and turned off in the morning.

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Estimating the Stock.

Estimates have varied so far from actual counts - as shown when the stock is transplanted or distributed - that it was decided a different scheme for making the estimate was necessary.

The actual amount of stock invariably fell below the istimate. This was due chiefly to one thing:

In estimating the seedlings, one or several assumed average beds were estimated by taking a count from a foot square frame set in that part of the bed supposed to be a fair representation of the whole bed. Just a few of these counts were made and the estimate of all that plot based on these.

In the first place, a person is bound to favor a better rather than an average bed, and second, the frame will be set in the best part of the bed. And even though this were not true in some cases, it would be impossible to pick out a bed or several beds from a plot of 100 that would give a fair average for all. When the stand is, say 10,000 per 48 square feet, a difference of 1,000 one way or the other cannot be perceived by a casual glance.

Likewise in the transplants, a hit or miss shot at a few of the rows assumed to be average ones, will be the basis for all the transplants. The tendency is to boost the work, or feel sure of its result that the best rows are really picked as average.

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Likewise in the transplants, a bit or miss shot at a few of the rows assumed to be average ones, will be the basis for all the transplants. The tendency is to boost the work, or feel sure of the result that the best rows are really picked as average.

To do away with the tendency to boost the result of sowing or transplanting, the methods outlined in the following instructions for estimating at Savenac Nursery have made the selection mechanical, and sufficient counts made to well represent the stand.

The fall estimate of all stock on hand was made by the following methods. We were able to check results on one plot of transplants when the stock was distributed. The estimate was 167,000. The actual number of trees gotten out was 180,000.

METHOD OF ESTIMATING SEEDLING STOCK AT SAVENAC NURSERY.

The counts will be made from a frame six inches wide and of indefinite length, so as to provide for the slightly varying widths of the seed beds. The frequency of the counts will be dependent upon the following scheme:

The total estimate will be made by three methods, called "Method 1, 2 and 3."

Method 1.

A count will be made from one setting of the frame, four feet from the end of every other bed. The settings should alternate in respect to the end of the bed. That is, if the first count is taken from the east end of a bed, the count of the second bed parallel to it will be taken from the west end. The number of trees in

this frame multiplied by twice the length of the bed - in feet - will give the total number of trees in the bed. The counts for each bed estimated are recorded on Form Sn-10, in order that a check may be had when re-estimating for germination, loss, or the like. When one-half the total number of beds has been estimated, the sum total is taken and the average per bed computed. This result multiplied by the total number of beds in the area will give the total stand of seedlings.

Method 2.

A count will be made from one setting of the frame, four feet from the end of every bed. As in Method 1, to distribute the counts as well as possible over the area, in parallel beds bed #1 will be counted on the east end, bed #2 on the west end, bed #3 on the east, etc. The counts in each bed are then multiplied by twice the length of the bed, and this result added with those of the others for the total stand.

Method 3.

This method differs from the two previous ones in that a count will be taken from each end of every bed. The sum of the two counts is multiplied by the length of the bed for the number of trees in that bed, and the results of each bed added for the total stand.

this frame multiplied by two or the length of the bed - in feet - will give the total number of trees in the bed. The counts for each bed estimated are recorded on Form Sm-10. In order that a check may be had when re-estimating for examination, loss, or the like. When one-half the total number of beds has been estimated, the sum total is taken and the average per bed computed. This result multiplied by the total number of beds in the area will give the total stand of seedlings.

Method 2.

A count will be made from one setting of the frame. Four feet from the end of every bed. As in Method 1, to distribute the counts as well as possible over the area, in parallel beds beds 1/4 will be counted on the east end, bed 1/2 on the west end, bed 3/4 on the east, etc. The counts in each bed are then multiplied by twice the length of the bed, and this result added with those of the others for the total stand.

Method 3.

This method differs from the two previous ones in that a count will be taken from each end of every bed. The sum of the two counts is multiplied by the length of the bed for the number of trees in that bed, and the results of each bed added for the total stand.

SELECTION OF METHOD.

Now compare the estimates of the stand made by the three methods.

Method 3 will be most accurate, so #3 will be considered 100% efficient. By the "Law of Probabilities" Method 2 will be more efficient than Method 1. But in a series of estimates on this scale, we will find that the relation between the ratios of Method 2 to Method 3, and Method 1 to Method 3 will vary. Method 3 is too expensive. Method 2 will perhaps be 98% efficient, and Method 1, 96%. In this case it will be cheaper to use Method 1, since the difference in efficiency is only 2%, yet the cost of Method 2 is double that of Method 1.

In estimating for selection of method to be used, Methods 1 and 2 can be taken from the notes on Method 3.

SELECTION OF METHOD.

Now compare the estimates of the error made by the three methods.

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In estimating for selection of method to be used, Methods 1 and 2 can be taken from the rotem on Method 3.

Form SN-10.

SEEDLING ESTIMATE

Savenac Nursery Date_____

Stock_____

Bed No.	End	Length	Count	Total

Totals

In Area

Total Beds: Avr. per Bed per Sq.Ft. Stand

Method_____ Estimated By_____

Form SM-10.

BASELINE ESTIMATE

Surveyed Nursery Date_____

Stock_____

Bed No.	Bed Length	Count	Total

Totals

In Acres

Total Beds Avr. per Bed per Sq.Ft. Stand

Method_____ Estimated By_____

METHOD OF ESTIMATING TRANSPLANTS

AT SAVENAC NURSERY.

The counts will be taken from the setting of a straight strip of wood the length of the transplant boards - 8½ feet - placed alongside the row.

The first count will be taken 8½ feet from the end of the first row in the first bed. Every other bed is skipped, so the second count will be 8½ feet from the end of the second row in the third bed, and the third count in the third row of the fifth bed, etc., etc., until the area has been crossed.

Then the estimator will come back in the center of the area, selecting his settings in the same mechanical manner. The beds in which the counts are made on this trip, however, are those that were skipped when the area was first crossed.

The third trip across the area is made 8½ feet from the opposite end of the rows first estimated.

The data obtained is noted on the special forms for this purpose (Form SN-10a).

From these notes the average per board is computed, and the per cent loss, based on the seventy-five trees per board, obtained. This per cent loss is deducted from the total transplanted, the result being an estimate of the present stand.

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The third trip across the area is made 8½ feet from the opposite end of the rows first estimated.

The data obtained is noted on the Special forms for this purpose (Form SM-108).

From these notes the average per board is computed, and the per cent loss, based on the seventy-five trees per board, obtained. This per cent loss is deducted from the total transplanted, the result being an estimate of the present stand.

Form SN-1Ca.

TRANSPLANT ESTIMATE

Savenac Nursery Date

Stock

End	Bed	Row	Count	Remarks

Totals

Estimated By

Form SE-106.

TRANSPLANT RETURNS

Sevmeo Nursery Date_____

Stock_____

Bed	Bed	Row	Count	Remarks

Totals

Matched By_____

Stock Distribution.

1. Spring Distribution.

The spring stock distribution was carried on very much the same as in the past, with the exception of one important change, namely, a horse-drawn tree digger. Formerly the stock was lifted by spades,- another man-killing job. A Feighly Tree Digger was purchased and tried out.

The implement is very much on the order of a plow, except that the share is an L-shaped knife, and the device drawn by two horses in tandem. The knife cuts the trees about seven inches below the surface. A wedge-shaped piece of iron attached to the knife blade an inch back of the cutting edge causes the row of trees to slide up this incline made by the wedge, which is thus raised sufficiently to result in a sort of separation of the roots and breaking of the soil when the slice of earth falls back into place, as it were, behind the plow, so that the trees are easily pulled from the ground, yet the roots are not at all exposed. As with the trencher plow, one man drives the horses and one guides the plow.

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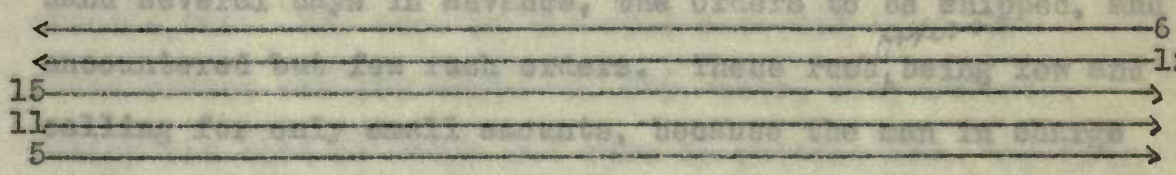
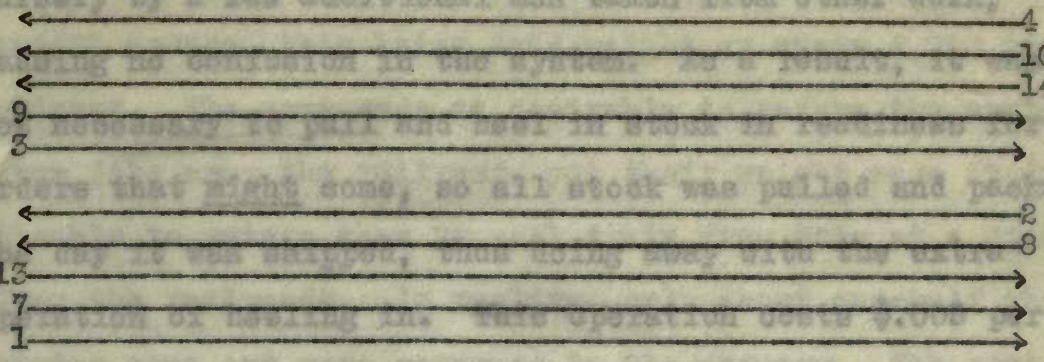
causing the share to come to the surface. Instead of stopping, the plowmen would go right on, working the plow back into place on the "run". As a result, many trees would be cut too shallow. Readjustment of the clevice and handles was also necessary before the plow could be easily guided.

Where it formerly took one man to lift with a spade what two men pulled, two men can now lift with the tree digger enough to keep twenty men busy pulling.

The advantage of making long rows in transplanting is renewed in tree lifting, because turning at the end of each row takes considerable time, and it is often necessary to dig up the ends of the plot by hand to allow turning room for the horses.

The order in which the rows are lifted with the Foighley Tree Lifter is indicated in the following diagram. This order is necessary to allow members of a large crew to work without interfering with each other, and to allow time for pulling the first row before the one adjacent is plowed, to avoid any injury to the trees already lifted by the plow horse.





2. Fall Distribution.

Since distribution in the fall came at such an opportune time as to give it undivided attention, it was possible to carry on a number of experiments which it was believed would better the carrying out of that project as a whole. By the close of the season there was hardly a principle of the work that had not been changed from methods used in past years.

As already discussed under "Spring Distribution", the method of lifting the stock was entirely different.

Methods: Men in charge of the planting jobs were instructed to take particular pains in gauging the amount of stock they could plant per day, and so know several days in advance what to order. In this way the nursery had on hand several days in advance, the orders to be shipped, and encountered but few rush orders. These rush orders being few and calling for only small amounts, because the man in charge of the planting job was figuring as closely as possible what stock he needed per day, could be handled at the

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nursery by a few additional men taken from other work, causing no confusion in the system. As a result, it was not necessary to pull and heel in stock in readiness for orders that might come, so all stock was pulled and packed the day it was shipped, thus doing away with the extra operation of heeling in. This operation costs $.005 per thousand.

The men follow the tree lifter, pull the trees and tie them in bunches of 100 each, they lay the bunch down and cover the roots with a handful of dirt. It might be mentioned here that costs might be reduced an appreciable amount if some no-knot tying device can be conceived of. The present method of tying the bunches with string takes considerable time.

The packing is done just before train time when the trees are to be shipped. The bunches are thrown into the wagon and hauled to the packing machine, or carried in large wire baskets.

The stock was formerly packed in a specially designed shipping crate of two sizes, the smaller one holding on an average of 2,000 plants and the larger about 4,000. The cost of the wood material alone in these crates was 16½ cents and 27½ cents, respectively. Adding the cost of nails and work in putting them together, the total cost was about 18½ cents and 30 cents each. The

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weight of the larger box (which was the most economical) was 22 pounds, this being dead weight on every 4,000 trees shipped. The cost made it desirable to return the crates from jobs near the railroad, yet their weight made it impracticable to return them by pack train from jobs at a distance from the railroads. In reality, only about one-half the crates sent out were returned to the nursery. The crate was built to last two shipments, but for the reason given above, the cost of crating amounted to 75% of the initial cost of the crates. This brought the cost of crating 4,000 trees to 22 cents, or 5½ cents per 1,000. Packed, the boxes weighed about 110 pounds, a heavy and inconvenient container to handle.

This fall burlap rolls were used in all our shipments, in substitution for the old style wood crates. The device for making the rolls is somewhat on the order of a shingle weaving machine. (See photographs). Specifications for this device are being prepared for Ogden, in accordance with circular letter of June 14, 1915.

Two six-foot lengths of lath yarn fastened to two wooden cleats (the cleats eighteen inches apart and the two lengths of lath yarn twelve inches apart) two feet long by means of poultry netting staples are first placed in the bottom of the packer. A strip of burlap six feet long and twenty-one inches wide is placed over the lath yarn and cleats, and over the burlap is laid

a six-foot sheet of eighteen inch "Butcher's" wrapping paper. The bunches of trees, after being moderately pruned, are then laid in the packer in two tiers, roots to the center, each layer being well packed in wet shingle tow. When the container is full, the ends of paper and burlap are drawn together at the top. The ends of the burlap are wrapped around a good hard strip of wood, - tamarack - 1" x 2" x 2'. The ends of this stick will extend about two inches beyond the edges of the burlap. On these uncovered ends a grip is secured by means of a long tool - sixteen inches - similar to a wagon hammer. With this purchase the burlap can be twisted as tight as the tearing resistance of the burlap will permit. When the burlap has been drawn up good and tight, this wrenching tool is held in position by means of a catch on the packer. The hands are now free to tie the bundle with the lath yarn. This completes the operation. The front side of the packer is let down and the bundle taken out.

The burlap strips are saved in the field and at the close of the season shipped back to the nursery. It is not known what the life of the packing material is, but I am sure it will last three years. A comparison in cost of these two means of packing is shown in the following:

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Cost of Material for Tree Shipments.

Large Shipping Crate.		Burlap Roll.	
Number of trees per crate.....	4,000	Roll.....	4,000
Life	2 years.	3 years.	
Cost of material: Lumber	$ .28	Cleats	Scrap Lumber
		Rope	.036
		Paper	.018
		Burlap	.065
Labor	.02	.....	.030
Total	.30	.....	.14
Loss through breakage and amount not returned from field before the second shipment is 25%. Hence $ .30 is only 75% of the cost of the crates for a two-year service, and the total cost for that period is	.40	.....	.14
Cost of ..... moss	.12	Shingle tow ...	.012
Actual cost of crating 8,000 trees	$ .52	12,000 trees ..	.15
Cost per M.	$ .06½	.....	.01-1/

Cost of Material for Tree Shipments.

Large Shipping Crate.		Burlap Roll.	
Number of trees per crate......4,000		Roll..........4,00	
Life .... 2 years.		5 years.	
Cost of material: Lumber	$ .28	Cleats	Scr Lum
		Rope	.02
		Paper	.01
		Burlap	.06
Labor	.02	....	.02
Total	.30	....	.14
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Cost of .... moss	.12	Shingle tow ...	.01
Actual cost of crating 8,000 trees	$ .52	12,000 trees ..	.15
Cost per M.	$ .06½	....	.01

Aside from a considerable lowering of cost, the new method has other advantages, namely:

Advertisement: The bundles are attractive, and their open ends display the contents to a large number of people who see the loading of express shipments from the car windows.
Number of trees per bundle is flexible.
Bundles easier to handle en route than boxes.
One man can pack twice as many trees per day (approximately half a million).
A better pack for pack horses.
The average per bundle is 4,000 trees.
Weight, ninety pounds.
Easy to handle at the plantation. The bundle will not break like a box when thrown around. The whole bundle may be dipped in water if so desired, instead of individual bunches.

The trees do not dry out or heat, in the time it will take to transport them to any part of the District. These bundles have been left in a warm place for six days and the trees were cool and moist when the bundle was opened.

In the past, all trees were packed in sphagnum moss. Last spring some experimenting was done with shingle tow - the saw kerf from a shingle mill. The results were satisfactory, so all fall shipments were packed in this and a close record of the condition of the stock on arriving at its destination kept. All shipments were reported to have been received in good condition.

For short time shipments (at the most four days) the moss has no advantage over the shingle tow. The last order of moss came from Wisconsin, costing $30.00 per ton F.O.B. Haugan. It was necessary to fumigate this to rid the moss of the larch saw fly. The shingle tow, on the

other hand, is gotten at the shingle mill less than a mile from the nursery, at the cost of hauling only. Last fall, about seven tons were hauled and stacked at a cost of $2.00 per ton.

Shingle tow, like moss, will pack about 1,000 trees to the pound.

Each bundle is stenciled to show the number of trees, species and age class. Next year the new stencil - design of standard badge - supplied at Ogden, will be used on the bundles. Also the form on the following page, sealed in an oiled envelope, will accompany each consignment. This is a District 6 form.

Additional time studies with a stop watch will be made, and an attempt made to put the operations of this project on a sliding wage scale similar to that now used in transplanting.

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Savenac Nursery. September 15, 1915.

Dear Sir:

The following shipment of nursery trees consisting of 20 B'dles. is being made today via Northern Pacific on Government bill of lading No. 52963. consigned to Forest Supervisor, Sandpoint, Idaho.

Number M.	Number Rolls	Species	Age	Source of Seed	Remarks
40	10	W.W.P.	1-2	Kaniksu	Fertilized
20	5	W.W.P.	2-0	"	"
20	5	W.Y.P.	1-2	Bitterroot	Unfertilized

This is the final shipment of Western yellow pine Stock.

Please describe fully on the reverse side of the enclosed extra copy of this letter, the condition in which the trees reached you and forward it to the District Forester This information is desired in order that we may know whether changes are necessary in our methods of packing.

Very truly yours,

In Charge.

(Over)

Directions: Consignee should fill out this report in duplicate on the two forms received from the consignor, forward one to the District Forester and retain the other in the files.

Date shipment reached end of railroad or stage line. Sept. 16/15

Date received from railroad or stage company. Sept. 16, 1915.

Date unpacked at planting site.....

How were trees treated after receipt from transportation co.?

Watered in transit by pack train.

Heeled in at planting site.

Condition of rolls when received; describe in detail if in bad shape Good.

Ropes loosened on 2 bundles.

Condition of the trees: Were the roots moist or dry; was the packing of moss or shingle-tow moist or dry; was there any sign of heating; did the tops show any signs of wilting or of mildew; were they bruised or broken in any way; had any of the bundles become dislodged from their original position in the package; was there any difference in the condition of the trees in the middle of the package from those near the outside; in what condition were the trees as a whole?

Trees in excellent condition.

Date Sept. 18, 1915.

(Signed) .....

(Title) Forest Supervisor.

Seedling Stock Distribution: Seedling stock is lifted from the beds by means of spading forks. A horse-drawn implement that will lift the seedlings and can be converted into an underground root pruner for the seed beds is being worked on, but as yet it has not been perfected.

The seedling stock is pulled and packed in the same manner as the transplants.

Age of Transplant Stock When Shipped:

P. ponderosa 1-2

P. monticola ..... 1 & 2-2

P. strobus ..... 1 & 2-2

Picea Engelmanni 2-2

Larix occidentalis 2-2

Thuya plicata 2-2

Hardwoods ..... *

*Variable.

Labor.

There has been no difficulty in securing temporary labor at the nursery, at any time of the year. While most of this help consists of floaters, still there are sufficient old hands available to carry on the work smoothly.

Wages paid to the different classes of labor in 1915 were as follows:

Transplant crew	On a sliding wage scale.		
Initial wage on other crews.....	$2.75	per	day.
Experienced men in nursery work.....	3.00	"	"
Foreman	3.25	"	"
Teamster	3.25	"	"
Cook	50.00	"	mo.
Flunky	55.00	"	"

From these wages, the men pay 25 cents per meal. This amount covers the actual cost of running mess.

For the next year, the following changes in wages are contemplated:

1. The men on the Stock Distribution crew will be paid by piece rate.

2. The initial wage on other crews will be reduced to $2.50 per day.

3. The cook's wage will be raised to $55.00 per month.

The initial wage will be further reduced, until it is $2.25 per day, but it must be reduced gradually to this amount. When $2.25 has been standardized, the foreman

IMPROVEMENTS.

During the year 1915, a number of important improvements were made:

1. The high-line water ditch was constructed to give sufficient water for the seed beds and domestic purposes. The total cost of this ditch - which is over a mile long and flumed about 1,--- feet - was $885.00.

2. A pole bridge 60 feet long was laid over the slough in front of the nursery to enable us to get river sand whenever desired. Formerly it was necessary to go around over the county road bridge, then back and ford the river to the beach, making it about 1/4 mile hauls, and the sand had to be gotten when the water in the river was low, when fording was possible. This bridge also roduces the haul to about 500 feet. The cost of constructing the bridge was $38.00.

The nursery street and walks were filled with fine crushed rock. This rock is gotten close by from a rock slide. The clay and sand mixture with this rock serves as a fine natural binder, so the effect is very much like a macadamized road. Total expenditures on this work were $45.00.

A neat, three-pole fence was set out in front of the nursery and white-washed, at a cost of $1.25 per rod. A similar fence will be put up on the other side

IMPROVEMENTS.

During the year 1918, a number of important improvements were made:

1. The high-line water ditch was constructed to give sufficient water for the road beds and domestic purposes. The total cost of this ditch - which is over a mile long and flumed about 1,--- feet - was $385.00.

2. A pole bridge 60 feet long was laid over the slough in front of the nursery to enable us to get river sand whenever desired. Formerly it was necessary to go around over the county road bridge, then back and ford the river to the beach, making it about 1/4 mile haula, and the sand had to be gotten when the water in the river was low, when hauling was possible. This bridge also reduces the haul to about 500 feet. The cost of constructing the bridge was $30.00.

The nursery street and walks were filled with lime crushed rock. This rock is gotten close by from a rock slide. The clay and sand mixture with this rock serves as a fine natural binder, so the effect is very much like a macadamized road. Total expenditures on this work were $48.00.

A neat, three-pole fence was set out in front of the nursery and white-washed, at a cost of $1.85 per rod. A similar fence will be put up on the other side

of the road next year, in front of the nurseryman's house.

The District storehouse, formerly used for storing planting equipment and supplies, was converted into a barn. This building makes a roomy barn, having two single and a double stall, harness room and oat bins, and loft for 15 tons of hay.

The old tool house was made over to serve as an office, and the large bunk house converted into a tool and storehouse.

Sleeping accommodations are under construction in the way of four two-room bunk houses, each building for twelve men (See blue-print).

The moss house was put on skids and moved to the rear of the tool house, where it now serves as a blacksmith shop.

A special effort was made to line up all buildings, roads, fences and seed beds in a systematic order, but this work cannot be finished until the seedlings now occupying the beds have been taken up. Also, the grounds are being planted with various trees, hedges and shrubs, in an attempt to bring out the aesthetic value of the nursery. It is felt that an attractive nursery will add materially to the publicity work of the Service, because of the large number of tourists stopping at Savenac during the summer. The approach to the nursery on the "Yellowstone Trail" are advertised by large signs, as shown in the accompanying photograph. All

visitors are requested to enter their name and place of residence in the register kept at the nursery.

The following improvements are contemplated during the year 1916:

A telephone will be installed in the transplant field, in connection with the office 'phone.

I wish to recommend that a new suspension foot bridge be constructed across the St. Regis River. This crossing is used in pedestrian travel between the nursery and Haugan. The present bridge is not only dangerous, but a disagreeable appearing structure for the entrance to the nursery.

visitors are requested to enter their name and place of residence in the register kept at the nursery.

The following improvements are contemplated during the year 1913:

A telephone will be installed in the transplant field, in connection with the office 'phone.

I wish to recommend that a new suspension foot bridge be constructed across the St. Regis River. This crossing is used in pedestrian travel between the nursery and Hangar. The present bridge is not only dangerous, but a disagreeable appearing structure for the entrance to the nursery.

Approximate Cost of Improvements at Savenac Nursery up to January 1, 1916.

Nurserymen's house	$650.00
Office	172.00
Tool and storehouse	575.00
One-half interest in Lolo Forest and nursery bunk house	100.00
Cook house	575.00
Commissary	30.00
Stain and painting of rough buildings in above	125.00
Root cellar	50.00
Bath house	65.00
Barn	405.00
Wagon shed	50.00
Other buildings - wood shed - blacksmith's shop, meat house, etc.	300.00
Clearing, breaking and fertilizing the land	3,640.00
Fencing	200.00
Roads, culverts, bridges, walks, seeding pasture, etc.	490.00
Water system - ditches, gates, dams, flumes, etc.	1,490.00
Pipe fittings - water system	850.00
Shade andscreen frames	600.00
Tools, implements, cook house equipments, stoves, and miscellaneous small fixtures and equipment	2,800.00
Nursery team	450.00
Total	$13,617.00

Approximate Cost of Improvements

at Evergreen Nursery up to January 1, 1916.

Nurseryman's house	$600.00
Office	175.00
Tool and storehouse	275.00
One-half interest in Polo Forest and nursery bunk house	100.00
Cook house	275.00
Commissary	50.00
Stain and painting of rough buildings in above	125.00
Root cellar	50.00
Bath house	65.00
Barn	400.00
Wagon shed	50.00
Other buildings - wood shed - blacksmith's shop, meat house, etc.	300.00
Clearing, breaking and fertilizing the land	3,640.00
Fencing	300.00
Roads, culverts, bridges, walks, seeding pasture, etc.	450.00
Water system - ditches, pipes, dams, flumes, etc.	1,450.00
Pipe fittings - water system	650.00
Shade and screen frames	500.00
Tools, implements, cook house equipment, stoves, and miscellaneous small fixtures and equipment	2,800.00
Nursery team	400.00
Total	$13,617.00

POLICY.

Taylor's System of Management will be further carried on in general nursery practice. The development of this system, however, must be gradual, and every move made well studied out in every detail

In a broader sense, that is, in changes that will secure a greater prosperity for the management directly, - indirectly to the employee - and pave the way for carrying on all the work on a strictly scientific management basis, the management of the nursery can be bettered in leaps and bounds.

To illustrate: The hardest part in introducing radical changes in a system is to make the men give up their prejudice against any innovation, and their "stand patism" on the old way of doing things. A more scientific manner of handling mess, work animals, improvements and maintenance, and better systems of handling administrative work are crowding the nursery schedule for attention. Also new devices for othet projects are to be experimented with, while the slow progress of helping and coaxing out 100% efficiency from the employee and adjusting wage scales is being worked out with detailed time studies.

An inspection of all nursery stock will be made daily during the spring and summer, in order that any disease or other injury to the stock may be detected and remedied before considerable damage is done.

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An inspection of all nursery stock will be made daily during the spring and summer, in order that any disease or other injury to the stock may be detected and remedied before considerable damage is done.

It is believed that a revision in the cost keeping system at the nursery will be necessary. Up to date, all items listed under permanent improvements dating back to 1910 have been given a twenty-year life. While perhaps the greatest portion of the total expenditures for permanent improvement will outlive the twenty years, still there are many items which will not. An attempt will be made to judge the length of service of these last-mentioned items, and thus clear them from the books as soon as is justifiable.

All land charges, disbursements for clearing the land originally, and subsequent improvements in dirt ditches, have been charged annually on a twenty-year depreciation basis. This is clearly an error, since there is no depreciation whatever on land, but rather an increased value from year to year, both for land and ditches.

Nor should interest on the money expended for land improvements be charged, unless we make interest charges also for tools, implements and all items under permanent improvements.

From the summary of costs in this report, it is shown that, aside from the amounts expended directly on each project, $320.34 for Work Animals, $1,108.50 for Administration, $1,371.58 for Maintenance, and $681.88 for Apportionment of Permanent Improvements, must be

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apportioned among the six major projects. These amounts affec the actual cost of each project very appreciably, and as a res project costs of different nurseries cannot be fairly compared unless the cost keeping system is standardized.

I should like to have you inform me, whether or not all Forest Service nurseries charged to their costs of tree production:

1. Land charges.
2. All items under permanent improvements.
3. Clerical work done by officer in charge.
4. Ranger's, or other Forest officers' help.
5. The time the draft animals actually spent on each project, which at $1.00 per day would at the most amount to only $100.00 a year, or the cost of keeping the team when working and in the stable the year round.

I think it advisable to take these queries up with the Washington Office, in an attempt to standardize the cost keeping system.

Respectfully submitted,

(Signed) D. S. Olson

In Charge.

January 15, 1916.

apportioned among the six major projects. These amounts a

the actual cost of each project very appreciably, and as a

project costs of different nurseries cannot be fairly com-

pared unless the cost keeping system is standardized.

I should like to have you inform me, whether or

all Forest Service nurseries charged to their costs of tre

production:

1. Land charges.

2. All items under permanent improvements.

3. Clerical work done by officer in charge.

4. Ranger's, or other Forest officers' help.

5. The time the draft animals actually spent on each project, which at $1.00 per day would at the most amount to only $100.00 a year, or the cost of keeping the team when working and in the stable the year round.

I think it advisable to take these queries up with the Washington Office, in an attempt to standardize the cost keeping system.

Respectfully submitted,

(Signed) D. S. Olson

In Charge.

January 15, 1916.

Savanna Nursery Cash Item

Project 2 Calendar Year 1915

Disbursements	Second Year Trees Moved	Cost per Tree
Labor $377.34		
Merchandise 28.88		
Total $406.32	529	$ .80
Minor Project Appertionments:		
8. Work Animals ...23.39		$ .16
9. Administration.124.75		.86
10. Maintenance ... 61.84		.12
11. Permanent Improvements..118.64		.81
Total 412.71		.79
Grand Total..... $819.03		$1.59

APPENDIX.

Experimental beds are not included in the counts, since they are not included in estimates of stock on hand.

Savenac Nursery

Cost Data

Project 2

Calendar Year 1915

Disbursements		Second Year Seed Beds	Cost per Bed
Labor	$277.04		
Merchandise	29.28		
Total	$306.32	529	$ .58
Minor Project Apportionments:			
8. Work Animals ...	53.39		$ .10
9. Administration.	184.75		.35
10. Maintenance ...	61.93		.12
11. Permanent Improvements..	113.64		.21
Total	413.71		.78
Grand Total.....	$720.03		$1.36

Experimental beds are not included in the costs, since they are not included in estimates of stock on hand.

Savenac Nursery — Court Data

Project 3 — Calendar Year 1918

Disbursements	Second Year Seed Beds	Cost per Bed
Labor $277.04		
Merchandise 29.28		
Total $306.32	529	$ .58

Minor Project Appropriations:

8. Work Animals ...$2.30		$ .10
9. Administration.184.75		.85
10. Maintenance ... 61.93		.12
11. Permanent Improvements..113.64		.21
Total	413.72	.78
Grand Total.....	$720.05	$1.36

Experimental beds are not included in the costs, since they are not included in estimates of stock on hand.

Savenac Nursery Cost Data

Project 3 Calendar Year 1915.

Operation	Hours		
Transplanting	1075	$385.15	Including threading and planting.
Foreman	135	55.62	Time spent on irrigation charged to Project 4.
Plowman	152	60.30	Time spent on irrigation charged to Project 4.
Horse	160	20.00	
Horse Feed		10.00	
Teamster	34	13.94	For plowing and harrowing ground. Moving tables to and from field.
Taking up Seedlings	473	178.26	
Uncovering Transplants	164	62.67	Caring for transplants covered by dirt from plow.
Hardware		.15	
Total	2193	$786.09	

Total Transplanted 1,567,050. Actual cost of Transplanting $.50.

Minor Project Apportionments:		Per M.
8. Work Animals	$ 53.39	.03
9. Administration	184.75	.12
10. Maintenance	61.93	.04
11. Permanent Improvements	113.64	.07
	$413.71	.26

Apportionment from Minor Projects per M. $.26

Total Cost of Transplanting $.76

Seneca Nursery   Cost Data

Project 5   Calendar Year 1916.

Operation	Hours		Cost	Remarks
Transplanting	1076	....	$385.15	Including threading and plant[…]
Foreman	135	....	55.62	Time spent on irrigation char[…] to Project 4.
Plowman	152	....	60.30	Time spent on irrigation char[…] to Project 4.
Horse	160	....	30.00	
Horse Feed		....	10.00	
Teamster	34	....	13.94	For plowing and harrowing gro[…] Moving tables to and from fie[…]
Taking up Seedlings	475	....	178.36	
Uncovering Transplants	164	....	62.67	Caring for transplants covere[…] by dirt from plow.
Hardware		....	.15	
Total	2193		$796.09	

Total Transplanted 1,367,050. Actual cost of Transplanting $.[…]

Minor Project Apportionments:		Per M.
8. Work Animals	$ 35.39	.02
9. Administration	184.75	.13
10. Maintenance	61.93	.04
11. Permanent Improvements	133.64	.07
	$415.71	.26

Apportionment from Minor Projects per M. $.[…]

Total Cost of Transplanting $.[…]

Savenac Nursery — Cost Data

Project 4 — Calendar Year 1915

Disbursements		Total M.	Cost per M.
Labor	$356.52	1,388	$ .25
Minor Project Apportionments:			
8. Work Animals	$ 53.39		$ .04
9. Administration	184.75		.13
10. Maintenance	61.93		.04
11. Permanent Improvements	113.64		.08
Total	413.71		.29
Grand Total	$770.23		$ .54

Bayonne Nursery | Dept Data | Project A | October Year 1916

Maintenance	Total $.	Cost per $.
Labor	$256.80	1,308 $ .20
Minor Project Appropriations:		
8. Work Animals	$ 85.89	$ .04
9. Administration	164.78	.12
10. Maintenance	61.25	.04
11. Improvements	113.64	.08
Total	414.71	.32
Grand Total	$770.83	$ .54

Savenac Nursery Cost Data

Project 5 Calendar Year 1915

Disbursements		Total M.	Cost Per M.
Equipment & Supplies	$ 2.55	1,171	
Labor	258.45		
Total	$261.15	.....	$ 0.23
Minor Project Apportionments:			
8. Work Animals	53.39	.....	$ .05
9. Administration	184.75	.....	.16
10. Maintenance	61.93	.....	.04
11. Permanent Improvements	113.64	.....	.10
Total	$413.75	.....	$0.35
Grand Total	$674.86	.....	$0.58

Reverse Nurses Coast Beta

Project D December Year 1918

Disbursements Total M. Cost Per M.

Equipment & Supplies
$ 2.65 1,171
Labor 256.48
Total ..... $261.13 ..... $ 0.22

Minor Projects
Appropriations:

8. Work Animals 65.39..... $ .05
9. Administra-
tion .....184.78..... .16
10. Maintenance 61.93..... .04
11. Permanent
Improvements113.64..... .10
Total ..... $425.15 ..... $0.35

Grand Total ..... $674.86 ..... $0.58

Savenac Nursery — Cost Data

Project 6 — Calendar Year 1915.

Spring Stock Distribution

Disbursements			No. of M. Shipped	Cost per M.	
Labor	$588.20			$ .30	
Horse Hire	15.00		1,960	.01	
Moss	49.50			.025	
Shipping Crates.	34.53			.02	
Total		$687.23			.35
Minor Project Apportionments:					
8. Work Animals	33.32			.017	
9. Administration	117.60			.06	
10. Maintenance	39.20			.02	
11. Permanent Improvements	78.40			.04	
Total		268.52			.14
Grand Total		$955.75			.49

Fall Stock Distribution.

Labor	$343.78		1,131	$ .30	
Burlap	6.22			.005	
Merchandise	9.11			.008	
Total		$359.11			.31
Minor Project Apportionments:					
8. Work Animals	20.07			.017	
9. Administration	67.15			.06	
10. Maintenance	22.73			.02	
11. Permanent Improvements	35.24			.04	
Total		145.19			.14
Grand Total		$504.30			.45

Complete Total ... $1,460.05 Average Cost per M. ... $ .47